

Appl. No. 10/660,084
Amdt. dated November 17, 2004
Reply to Office action dated August 17, 2004

Amendments to the Specification:

1. Please replace paragraph [0003] with the following amended paragraph:

AC motors may be classed as low, medium and high voltage. Medium-voltage motors consume voltages from about 400V up to about 15kV and generate power levels up to about 20,000 Hp. For AC motor applications above about 400 Hp, it is typical in the industry to engineer a modular control system for the specific application at hand. One engineering technique used for these high end systems involves paralleling specially designed power modules (such as, rectifier, bus and inverter sections). Paralleling power modules allows flexibility in designing drive systems using a small number of available modules. A control interface specifically designed to interface with parallel power modules is used in such systems. Parallel power module control systems for medium-voltage motors are inherently expensive, owing to the amount of design engineering required to configure the system, the need for many system components and the number of system interconnections (such as, wires, bus bars etc.). This design approach for high power, medium voltage control systems leads to high cost. The sophisticated and technical nature of these medium-voltage, high power control systems restrict their use to highly specialized applications.

2. Please replace paragraph [0004] with the following amended paragraph:

In contrast, low voltage AC motors typically consume between about 240V and 600V and generate power levels up to about 800 Hp. Control systems for these low-voltage motors have become compact, integrated, and are produced in reasonably high volume, ~~that is to say, they are considered by the industry to be an "off the shelf" item.~~ These "integrated" control systems are inherently less expensive than the complex, engineered systems previously mentioned.

3. Please replace paragraph [0005] with the following amended paragraph:

A control system for an AC motor having a predetermined horsepower rating is provided.

Appl. No. 10/660,084
 Amdt. dated November 17, 2004
 Reply to Office action dated August 17, 2004

A plurality of integrated AC motor control systems are used, each of which comprises ~~an input~~ a rectifier section, ~~a DC bus section~~ an output inverter section and a controller section. Each integrated control system has a horsepower rating less than the AC motor to be controlled. A ~~common, 3-phase~~ polyphase AC input is applied to the rectifier section of each integrated control system and a ~~common, 3-phase~~ polyphase, variable frequency, pulse-width-modulated output is derived from ~~output the~~ inverter section of each integrated control system. A parallel controller interfaces with each integrated control system controller to provide a control system for an AC motor.

4. Please replace paragraph [0006] with the following amended paragraph:

A method of controlling an AC motor of predetermined horsepower is also provided. The method involves providing a plurality of integrated AC motor control systems each having a horsepower rating less than the AC motor to be controlled. Further, each integrated control system comprises ~~an input~~ a rectifier section, ~~a DC bus section~~ an output inverter section and a controller section. ~~3-phase~~ Polyphase AC power is input to the rectifier section of each integrated control system. A ~~3-phase~~ polyphase, variable frequency, pulse-width-modulated power output from the output inverter sections of each integrated control system is generated and a parallel controller that has been interfaced with each integrated control system control provides control of the AC motor.

5. Please replace paragraph [0011] with the following amended paragraph:

State-of-the-art, three-phase AC motors use a sophisticated combination of solid state electronics, magnetic and/or vacuum contactors and other components configured into a control system. Such control systems ~~consist of~~ typically comprise four basic ~~functional~~ sections: (1) a input rectifier section that rectifies or converts incoming AC power into DC power; (2) a DC bus section that may also filter and condition the DC power; (3) an inverter section that converts the DC power into a pulse width modulated (PWM), variable-frequency AC signal; and (4) a control interface that allows a user to manipulate the control system and, therefore, the AC motor.

Appl. No. 10/660,084
Amdt. dated November 17, 2004
Reply to Office action dated August 17, 2004

7. Please replace paragraph [0013] with the following amended paragraph:

Figure 2 illustrates a modular, as opposed to integrated, AC motor control system for a medium voltage, high horsepower application. The control system 100 is comprised of a plurality of rectifier modules 110 for converting the incoming AC power 20 into a DC analog. The DC power is fed by an internal bus 115 to a plurality of inverter modules 120, which together supply a three phase, variable frequency, pulse-width-modulated AC power signal 130 to the AC motor or motors (not shown). Each rectifier module 110 typically has a rectifier interface card ~~115~~ 117 that interfaces the rectifier module to the rest of the system 100. ~~Likewise~~ Likewise, each inverter module 120 typically has an inverter interface card 125 that interfaces the inverter module to the rest of the system 100. Each rectifier module 110 and inverter module 120 typically has an associated heat exchanger 140 or other cooling device. Typically these cooling devices 140 use air or liquid as the cooling fluid. Modular control system 100 has an associated parallel controller 150 providing parallel control of the plurality of inverters and rectifiers. Parallel controller 150 typically has a master rectifier/inverter controller section or card 155 that communicates and interfaces with the rectifier interface ~~115~~ 117 and inverter interface ~~120~~ 125. It will be understood by those of skill in the art that reference to “cards” is merely one example of how conventional drives are organized and is not meant to limit the application of the present invention to other drive structures and designs. An example of a conventional modular control system is the OEMV3000 AC Variable Speed Drive in the Delta format offered by Oiffield-Electric-Marine, Inc. and designed for AC Motors over 315 kW, for example, a 600kW (800Hp) AC motor.

8. Please replace paragraph [0014] with the following amended paragraph:

FIG. 3 illustrates one embodiment of the present invention for an 800 Hp AC motor 200. Rather than engineer a modular control system for the 800Hp motor, such as that shown in FIG. 2, the present invention utilizes a plurality of off-the-shelf, integrated control systems rated for

Appl. No. 10/660,084
 Amdt. dated November 17, 2004
 Reply to Office action dated August 17, 2004

400 Hp motors, 210 and 220, respectively. In the specific embodiment illustrated in FIG. 3, two 400Hp integrated control systems, 210 and 220, are connected at their rectifier sections, 230 and 240, to a common, three phase AC power source 250. In the preferred embodiment of the invention illustrated in FIG. 3, the internal DC bus, 260 and 270, and any associated filters or ~~conditioner~~ conditioners 280 and 290, of each integrated control system, 210 and 220, remain separate one from the other. In an alternate embodiment, the internal DC buses, 260 and 270, of each integrated control system are connected to a common ~~external~~ DC bus 300. The output from the inverter sections 310 and 320 of each integrated control system are connected together to create a three phase, variable frequency, pulse-width modulated, AC power signal 330. Also shown in FIG. 3 is a controller 340, which ~~is~~ may be similar to the parallel controller 150 shown in FIG. 2, and includes a similar master rectifier/inverter controller section 345. Controller 340 interfaces with each integrated control system, 210 and 220, and allows user control of the parallel, integrated control systems.

9. Please replace paragraph [0015] with the following amended paragraph:

More specifically, the rectifier/inverter interface card 330 common to the integrated controllers is modified or even discarded and replaced with an interface card like those found in the modular systems, one of which is illustrated in Fig. 2. In this fashion, a plurality of independent, integrated drives are paralleled to control a motor having an Hp rating greater than ~~any~~ the Hp rating of the individual drives. The present invention can control 2 or more integrated drives in parallel, typically 3 to 8 drives. Moreover, the present invention may incorporate other conventional functionality, including but not limited to, dynamic brake systems or chopper circuits 400. As shown in Fig. 3, chopper circuit 400 may be common to the plurality of integrated drives or each drive may have its own chopper circuit. Additionally, the brake system may be intelligent or may be controlled by the drive controller 340.

10. Please replace the Abstract with the following amended paragraph:

A control system for a polyphase AC motor having a predetermined horsepower

Appl. No. 10/660,084
Amdt. dated November 17, 2004
Reply to Office action dated August 17, 2004

rating is ~~providing~~ provided comprising a plurality of integrated control systems each rated at less than the horsepower rating for the motor and having a rectifier section, an inverter section, and a controller section, and a parallel controller interfaced to each integrated control system.